DYMAR

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TECHNICAL HANDBOOK

A.F. SIGNAL GENERATOR
TYPE 2041

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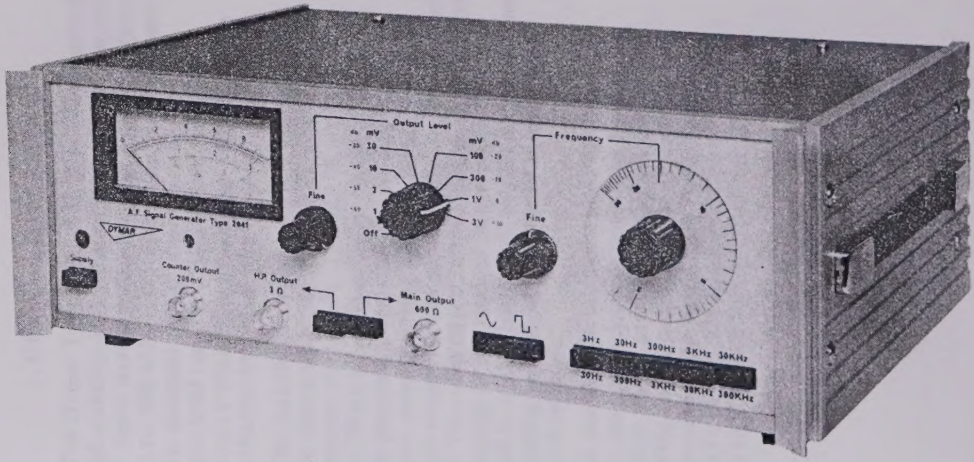


A.F. Signal Generator
Type 2041

1. GENERAL DESCRIPTION

The Dymar Type 2041 A.F. Signal Generator is a high stability, and low distortion general purpose A.F. signal source with a frequency coverage from 3 Hz to 300 kHz. It features a sine or square wave mode, constant output impedance with a wide output level range and high power output. It employs a Wien Bridge oscillator with amplitude stabilisation by means of a thermistor.

The maximum output level is 3 Volts R.M.S. in the sine wave mode, or 3 Volts peak to peak in the square wave mode. This can be attenuated by up to 70 db in 10 db steps by means of a 600 ohms precision attenuator. A fine amplitude control permits setting between steps so that the output voltage can be set precisely to the required level. The open circuit output voltage is monitored accurately on the integral meter, which is calibrated to read either R.M.S. or peak to peak values, depending on whether the sine or square wave mode is selected.

An ancillary db scale of -10 to +2 db allows direct reading in decibels relative to 1mW. The ancillary socket provides a constant output from the oscillator for accurate adjustment and monitoring of the frequency. There is also a 'High Power' socket which provides an output of up to 3 Watts into a load of 3 ohms.

2. SPECIFICATION

Frequency Range	3Hz – 300 kHz, sine or square wave in five ranges:- 3 Hz – 30 Hz 30 Hz – 300 Hz 300 Hz – 3 kHz 3 kHz– 30 kHz 30 kHz– 300 kHz
Frequency Calibration	3% ± 3 Hz
Frequency Stability	After a one hour warm-up period the frequency stability over a 10 minute period is better than 0.01% at constant temperature.
Counter Output	Constant level output of 200 mV from 100 ohms output impedance. Fine frequency control permits precise setting of wanted frequency.
Output Level	Adjustable 0 - 1mV up to 0 - 3V e.m.f. in eight ranges of 1 - 3 - 10 sequence.
Level Setting Accuracy	Better than 3% on integral level meter.
Attenuator Output Impedance	600 ohms ± 2% unbalanced.

Harmonic Distortion	Less than 0.1% from 100 Hz to 30 kHz Less than 0.3% from 30 Hz to 300 kHz Less than 3% from 3 Hz to 30 Hz.
Hum and Noise	Less than 0.05%. No hum when operated from internal battery.
Square Wave Output	Adjustable 0 - 1mV to 0 - 3V p-p from 600 ohms. Rise time better than 0.3 nS.
High Power Output	Adjustable 0 - 3V into any impedance of 3 ohms or more (i.e. 3W maximum, for sine wave outputs 100Hz - 10 kHz). Harmonic distortion: less than 2.5% at maximum power. Output Impedance: 0.5 ohms in series with 1000 μF.
Meter	Precision 8 cm movement, calibrated 0 - 3, 0 - 10 and a db scale of -10 to +2 db for relative measurement.
External Power Supply	190 - 260V AC, 95 - 130V AC, 50 - 60Hz.
Internal Battery Option	25V (nominal) Nickel Cadmium rechargeable battery of 225 mAh capacity, giving a typical operating time of three hours between re-charging. Batteries

Internal Battery Option (Contd)	are normally on permanent trickle charge or can be re-charged in 14 hours from a fully discharged condition (23V) using the charging circuit which is integral with the battery option. The "supply on" LED acts as a battery charge indicator. NOTE: The square wave and high power output facilities are only available on AC mains operation.
Dimensions and Weight	Width Height Depth Weight* 36.8cm 12.0cm 24.2cm 4.5kg 14.5in. 4.75in. 9.5in. 9.9 lbs. * with battery
Accessories	Rack mounting adaptor kit – Type 1901. Protective simulated leather carrying case – Type 1902. Typical figures based on normal operating conditions.

Dymar policy is one of continuous improvement, therefore the right is reserved to change specifications without notice.

3. OPERATION

3.1 Power Supply

The instrument as despatched from the factory is normally set for 230V operation and no further tap changes or adjustments are necessary, provided the mains voltage is between 190V and 260V AC. If the mains voltage is in the range 95V to 130V AC, then the primary windings on the transformer have to be connected in parallel and not in series. In order to do this, remove the top and bottom covers from the Instrument and make the following adjustments on the terminal block (i.e. voltage selector), which is situated on the back panel. Remove the link which connects pins 2 and 3 and substitute it with two links between pins 1 and 3 and pins 2 and 4. Also replace the 150 mA fuse with an equivalent type, but rated for 300 mA.

To operate the instrument from the mains supply, push the button on the front panel marked SUPPLY and LED pilot lamp will then light up indicating that the L.T. is ON. When the Instrument is fitted with internal battery, to operate it from mains supply, slide the switch on the back panel marked MAINS—BATTERY to MAINS and push the button marked SUPPLY. The pilot lamp will then light up.

To operate the instrument from its own internal battery, slide the switch on the back panel to BATTERY, and push the button marked SUPPLY. The pilot lamp will then light up if the battery is in charged condition. If the battery is discharged, the pilot lamp will not light up and the battery must be recharged. This is done by connecting the

Instrument to the mains supply (as described above) and sliding the switch on the back panel marked CHARGE FAST – TRICKLE to CHARGE FAST.

A discharged battery, i.e. 23V can be fully recharged in 14 hours. When the battery is charged, slide the switch to TRICKLE, and the battery is now on permanent trickle charge.

3.2 Measurement

Switch on the supply. The following front panel controls are available to the user:

Five frequency range, push button switches.
Main, coarse frequency setting dial.
Fine, frequency tuning control.
Sine/Square-wave push button switch.
Nine position rotary output level attenuator switch.
Fine output level control.
Main output/high power output push-button switch.

Frequency setting-up procedure. – Push the appropriate frequency range switch and rotate the dial to the required frequency. The fine frequency control permits more accurate setting of the required frequency.

Output level setting-up procedure – Rotate the output level attenuator switch to the required range and adjust the fine output level control to obtain the required level. In the sine-wave mode the open circuit output level is monitored on the meter. The internal output impedance of the "main output" socket is 600 ohms and therefore

connection of an external load of 600 ohms will make the voltage across the output socket (and load) to be exactly half of the indicated level on the meter. For any other load resistance "R" the relationship between the open circuit voltage E.M.F. and the actual voltage V across load is given by the formulae:

$$V = EMF \times \frac{R}{R + 600}$$

In the square-wave mode the peak to peak level is monitored on the meter.

In the high power output mode the meter indicates p.d. across the load.

4. TECHNICAL DESCRIPTION

The Generator consists basically of a "Wien Bridge" type oscillator and maintaining amplifier VT201, VT202 and VT206. (See drawing No. A2-104786). Positive feedback is applied to the base of VT201 via the "Wien Bridge" network and this induces oscillations at the "resonant frequency" of the network. At the same time, negative feedback is applied to the emitter of VT201 through thermistor TH201, to stabilise the output amplitude. The "Wien Bridge" network which determines the frequency of oscillation is switched in five steps by S201 A-B – S205 A-B, which brings in different capacitance values for the different ranges, and is continuously tuned across each range by the ganged potentiometers RV1A-B. The constant output for monitoring purposes is taken from the emitter of VT207.

In the sine wave, "main output" mode of operation the output voltage is taken from the emitter of VT206 via S206 A-B to the "Fine" output control potentiometer RV3 and then applied via S209B to the output stage VT208 and VT209. This consists of a "super" emitter follower with negative feedback from the collector of VT208 to the base of VT209. This results in an output impedance of only a few ohms at the emitter terminal of VT208 which, in conjunction with R239 gives the output impedance of the generator.

In the square wave, "main output" mode of operation, signal from the emitter of VT206 is fed via S206B and S207A to the squaring circuit

consisting of transistors VT203 and VT204. The square wave appearing across the load resistance R215 is applied to the "Fine" output level control potentiometer RV3 and then via S209B to the output stage VT208 and VT209.

In the sine or square wave mode of operation, main output, the output voltage appearing at the low impedance point of the emitter follower VT208, is also applied via S209A and S207B to the two stage D.C. coupled amplifier VT210 and VT211, where it is further amplified before it is fed to the rectifying diodes D204 and D205. The resultant DC voltage is used to drive the meter. In the high power mode of operation the p.d. appearing across the load is applied via S209A and S207B to amplifier VT210 and VT211.

The output attenuator consists of one 10 db pi-pad R1-R3, one 20 db pi-pad R4-R6 and one 40 db pi-pad R7-R9 all of 600 ohms impedance (see Drawing No. A3-104920). The switching of S1A-D is so arranged as to get values from 0 - 70 db in 10 db steps.

The design of the power supply is conventional and consists of transformer T1 and rectifying bridge D101 giving "raw" DC across capacitor C101. This voltage is applied to the regulator which produces a stable voltage of approximately 25V across pins 4 and 9. Zener Diode D102 provides reference voltage for the series transistor VT101 of the regulator, (see Drawing No. A2-105032).

The internal battery is recharged via polarising diode D1001 and resistor R1001 or resistor R1002.

When the equipment is supplied from mains, the pilot lamp D1 connected between pins 6 and 7 and via resistor R103 to common is used as the DC SUPPLY ON-OFF indicator.

When the equipment is energised from its internal rechargeable battery, the pilot lamp D1 is used not only as the DC SUPPLY ON-OFF indicator, but also as the battery state-of-charge indicator. This is achieved by connecting the pilot lamp D1 via resistor R103 to the collector of VT1001 transistor. Zener Diode D1002, resistor R1003 and trimming potentiometer RV1001 provide stable bias for the base of VT1001 transistor.

Potentiometer RV1001 is adjusted so that when the battery is discharged to 23V, i.e. 1.1V/cell, transistor VT1001 stops conducting, thus switching the pilot lamp D1 off.

An additional power supply (to that described above) is provided for the high power amplifier I.C. X 201. The "raw" DC appearing across C101 is fed via S101A, R228 to the regulator consisting of reference diode D201, VT205, and VT1, which produces a stable voltage of approximately 15V.

5. ALIGNMENT PROCEDURE

5.1 If re-alignment of the instrument is required, remove the top and bottom covers. All test points and pre-set controls are now accessible for adjustment. Do not adjust or tamper with these controls unless adequate test gear is available for the proper calibration of the Instrument.

5.2 The following test gear is required:

i) Oscilloscope 1 MHz bandwidth.

ii) Wide Band Voltmeter with 1% measuring accuracy.

iii) Frequency Counter.

iv) Distortion Factor Meter.

v) Resistance Bridge with 1% measuring accuracy.

vi) A.F. Output Power Meter.

vii) Peak Reading Voltmeter with 1% measuring accuracy.

viii) D.C. Power Supply Unit 0-30V 0.1A.

5.3 Checking of the Attenuator Impedance

Switch on the supply. Connect the resistance bridge to the "Main Output" socket SK2 and check that the impedance is within the specified limits at any setting of the "Output Level" switch S1A-D.

5.4 Frequency Calibration

Adjust C238 and C239 to mid-position. Connect the Frequency Counter to the "Counter

Output" socket SK3. Push the range switch S203A-B (i.e. 300 Hz – 3000 Hz) and set the "Fine Frequency" control RV2A-B to mid position. Rotate the "Coarse Frequency" control RV1A-B to obtain 1000 Hz reading on the Counter and adjust (mechanically) the frequency dial to indicate 10. Check that any other frequency setting indicated by the dial is within the specified limits on all five ranges. To obtain more accurate calibration at the highest frequency i.e. 300 kHz, adjust C238 and C239.

NOTE: C238 and C239 must be adjusted by the same amount.

5.5 Adjustment of Mark-Space Ratio

With the instrument in its square wave mode, connect oscilloscope to the "Main Output" socket SK2. Adjust potentiometer RV204 to obtain a 1:1 mark-space ratio of the Schmidt trigger circuit.

NOTE: The square wave mode of operation is available only when the instrument is supplied from AC mains.

5.6 Main Output Level Adjustment

With the instrument in its sine wave mode, set to 300 kHz, connect the Wide Band Voltmeter to the "Main Output Level" socket SK2. Rotate the "Output Level" switch S1A-D to the 3V range and the "Fine Output Level" control RV3 fully clockwise. Set pre-set potentiometers RV205, RV206 and RV207 to mid position. Adjust RV202 to obtain a reading of 3.16V R.M.S. on the wide-band voltmeter, and adjust RV206 so that the meter reads the same voltage (i.e. f.s.d. on the "10" scale)

as shown on the external voltmeter. If f.s.d. reading is unobtainable adjust RV207. Check that the level indicated at any other setting of the "Output Level" switch and "Fine Output Level" control is within the specified limits over the whole frequency range of the instrument.

To calibrate the meter when the instrument is in its square wave mode, repeat the procedure as described above, but adjusting RV205 instead of RV206 to obtain 3.16V peak to peak (i.e. f.s.d. on the "10" scale).

NOTE: If a peak reading voltmeter is not available, a conventional voltmeter may be used which is calibrated in R.M.S. values of sine wave but responds to an average value of the voltage then the reading on the external voltmeter should be 1.74V.

5.7 High Power Output Adjustment

With the instrument in its sine wave mode, set to 1000 Hz, connect the AF Power Meter set to 3Ω to the "High Power" output socket SK4. With the "Fine Output Level" control RV3 set fully clockwise, adjust RV208 for 3 Watts output indicated on the A.F. output meter.

NOTE: High power output is only obtainable in the sine wave mode of operation when the instrument is supplied from AC Mains.

5.8 Checking of the Harmonic Distortion

With the instrument in its sine wave mode, connect the Distortion Factor Meter to the "Main Output" socket SK2 and check that the distortion is within the specified limits over the

whole frequency range of the instrument at maximum or any other setting of the output level. With the instrument in the "High Power" mode, connect the Distortion Factor Meter to the "H.P. OUTPUT" socket SK4 and check that the distortion is within the specified limits over the frequency range and at any setting of the output level.

5.9 Checking of the setting of RV1001 (battery supply)

Remove wire from pin 7 and connect d.c. supply to pins 6 and 7 (+ve to pin 7 and −ve to pin 6), set accurately to 23V. Slide BATTERY-MAINS switch S1002 to BATTERY and adjust RV1001 so that the transistor VT1001 just stops conducting, thus switching off the pilot lamp D1. Check that when the P.S.U. voltage is slightly increased D1 lights up.

6. COMPONENTS LIST

NOTE: All resistors are in ohms and all capacitors are in μF, unless otherwise stated.

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
6.1	**Resistors**			
R1	Metal Film	1150	½	½W
R2	Metal Film	856	½	½W
R3	Metal Film	1150	½	½W
R4	Metal Film	732	½	½W
R5	Metal Film	2980	½	½W
R6	Metal Film	732	½	½W
R7	Metal Film	612	½	½W
R8	Metal Film	30K	½	½W
R9	Metal Film	612	½	½W
R10	Metal Film	604	½	½W
R201	Wirewound	0.24	10	5W
R202	Metal Film	1	10	¼W
R203	Carbon Film	100	5	½W
R204	Carbon Film	68K	5	½W
R205	Carbon Film	10K	5	½W
R206	Metal Film	1.5K	1	½W
R207	Carbon Film	3.9K	5	½W
R208	Carbon Film	3.9K	5	½W
R209	Carbon Film	680	5	½W
R210	Metal Film	1.5K	1	½W
R211	Carbon Film	1.5K	5	½W
R212	Carbon Film	150	5	½W

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
R213	Carbon Film	1K	5	½W
R214	Carbon Film	10K	5	½W
R215	Carbon Film	1.2K	5	½W
R216	Carbon Film	1K	5	½W
R217	Carbon Film	12K	5	½W
R218	Carbon Film	10K	5	½W
R219	Carbon Film	560	5	½W
R220	Carbon Film	68K	5	½W
R221	Carbon Film	270	5	½W
R222	Carbon Film	10K	5	½W
R223	Carbon Film	100	5	½W
R224	Carbon Film	8.2K	5	½W
R225	Carbon Film	8.2K	5	½W
R226	Carbon Film	8.2K	5	½W
R227	Carbon Film	2.2K	5	½W
R228	Wirewound	18	10	13W
R229	Carbon Film	10K	5	½W
R230	Carbon Film	180	5	½W
R231	Wirewound	680	10	5W
R232	Carbon Film	150	5	½W
R233	Carbon Film	4.7K	5	½W
R234	Carbon Film	47	5	½W
R235	Carbon Film	15K	5	½W
R236	Carbon Film	33K	5	½W
R237	Carbon Film	1.5K	5	½W
R238	Carbon Film	100	5	½W

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
R239	Metal Film	604	1	½W
R240	Carbon Film	220	5	½W
R241	Carbon Film	4.7K	5	½W
R242	Carbon Film	220	5	½W
R243	Carbon Film	3.9K	5	½W
R244	Carbon Film	15K	5	½W
R245	Carbon Film	2.7K	5	½W
R246	Carbon Film	10K	5	½W
R247	Carbon Film	3.9K	5	½W
R248	Carbon Film	100	5	½W
R249	Carbon Film	6.8K	5	½W
R250	Carbon Film	10K	5	½W
R251	Carbon Film	100	5	½W
R252	Carbon Film	22K	5	½W
R253	Carbon Film	27K	5	½W
6.2	**Capacitors**			
C201	Met. Polyester	1	1	63V
C202	Polystyrene	0.1	1	30V
C203	Polystyrene	0.01	1	30V
C204	Polystyrene	950p	1	30V
C205	Polystyrene	56p	1	30V
C206	Met. Polyester	1	1	63V
C207	Polystyrene	0.1	1	30V
C208	Polystyrene	0.01	1	30V
C209	Polystyrene	950p	1	30V

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
C210	Polystyrene	56p	1	30V
C211	P.E.T.P.	0.1	10	100V
C212	Polystyrene	0.0033	1	30V
C213	Polystyrene	680p	1	30V
C214	Electrolytic	1000		16V
C215	Electrolytic	100		25V
C216	Electrolytic	100		25V
C217	Electrolytic	470		10V
C218	Electrolytic	100		25V
C219	P.E.T.P.	0.1	10	100V
C220	Ceramic	0.047		25V
C221	Ceramic	22p	5	200V
C222	Electrolytic	10		25V
C223	Electrolytic	10		25V
C224	Electrolytic	150		16V
C225	Electrolytic	47		25V
C226	Electrolytic	150		16V
C227	Electrolytic	10		25V
C228	Electrolytic	100		25V
C229	Electrolytic	150		16V
C230	Ceramic	22p	5	200V
C231	Electrolytic	150		16V
C232	Electrolytic	47		25V
C233	Electrolytic	150		16V
C234	Polyester	6.8	20	63V
C235	Polyester	6.8	20	63V

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
C236	Electrolytic	150		16V
C237	Electrolytic	150		16V
C238	Not Used			
C239	Not Used			
C240	Ceramic	0.003		500V
C241	Ceramic	56p	5	200V
C242	Not Used			
C243	Ceramic	27p	5	200V
C244	P.E.T.P.	0.1	10	100V
C245	P.E.T.P.	0.1	10	100V
C246	Electrolytic	470		25V
C247	Electrolytic	220		25V
C248	Ceramic	150p	10	200V
C249	Polystyrene	33p	1	30V
C250	Polystyrene	33p	1	30V

6.3 Semiconductors

VT1	Transistor, NPN, RCA,	2N5296
VT201	Transistor, NPN, Texas,	BC183LA
VT202	Transistor, NPN, Texas,	BC183LA
VT203	Transistor, NPN, Motorola	2N3904
VT204	Transistor, NPN, Motorola	2N3904

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
VT205	Transistor, NPN, Mullard	2N1711		
VT206	Transistor, NPN, Texas	BC183LA		
VT207	Transistor, NPN, Texas	BC183LA		
VT208	Transistor, NPN, Texas	BC183LA		
VT209	Transistor, NPN, Texas	BC183LA		
VT210	Transistor, NPN, Texas	BC183LA		
VT211	Transistor, NPN, Texas	BC183LA		
X201	I.C., S.G.S.,	TBA810AS		
D1	L.E.D. Opcoa, wide angle red.			
D201	Zener Diode INT. RECT.	5ZS17B	5	17V,5W
D202	Zener Diode INT. RECT.	IZM20T5	5	20V,1W
D203	Zener Diode INT. RECT.	IZM16T5	5	16V,1W
D204	Ger.diode Mullard	OA91		
D205	Ger. diode Mullard	OA91		

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
6.4 Variable Resistors				
RV1A-B	Wirewound, Dual Ganged, Semi-log A,	50K+50K	2	4W
RV2A-B	Wirewound, Dual, Ganged, Linear,	500 + 500	10	2W
RV3	Carbon Linear,	10K	20	½W
RV201	Preset, cermet, 90H	470	10	½W
RV202	Preset, cermet, 90H	1K	10	½W
RV203	Preset, cermet, 90H	470	10	½W
RV204	Preset, cermet, 90H	1K	10	½W
RV205	Preset, cermet, 90H	2.2K	10	½W
RV206	Preset, cermet, 90H	2.2K	10	½W
RV207	Preset, cermet, 90H	4.7K	10	½W
RV208	Preset, cermet, 90H	1K	10	½W
6.5 Variable Capacitors				
C238	Ceramic, 10mm	4-20p	10	250V
C239	Ceramic, 10mm	4-20p	10	250V

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*

6.7 Miscellaneous

SIA-D	Output level switch, rotary, Dymar Drawing No. A3-104919			
S201A-B to S205A-B	Frequency range switch, 5 Module 2-Pole C/O Interdependent, SC 150			
S206A-B to S207A-B	Sine/square wave mode switch, 2 Module 2 Pole C/O Interdependent, SC150.			
S208A-B to S209A-B	Main output/High power output switch, 2 Module 2 Pole C/O, Interdependent, SC150.			
TH201	Thermistor RA54, I.T.T.			
SK2	BNC-Bulkhead Socket, 50Ω			
SK3	BNC-Bulkhead Socket, 50Ω			
SK4	BNC-Bulkhead Socket, 50Ω			

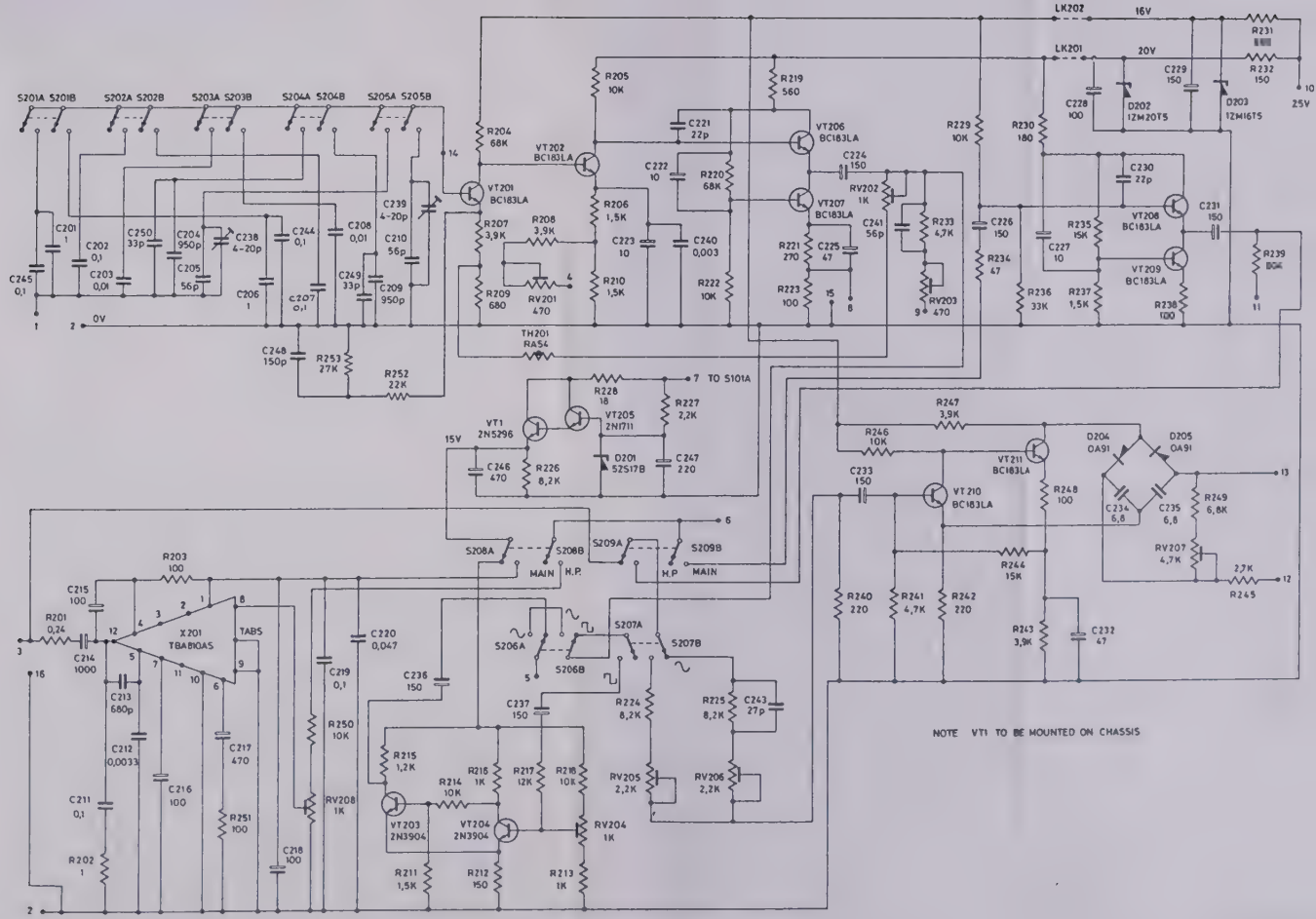
6.8 Mains Supply Components

R101	Carbon film	1K	5	½W
R102	Carbon film	15K	5	½W
R103	Carbon film	2.2K	5	½W
C101	Electrolytic	2200		63V
VT101	Transistor, NPN, RCA		2N5296	
D101	Bridge Rect, Int.Rect.	1SB 10A		100V,1A
D102	Zener diode, Int.Rect.	1ZM 27T5	5	27V 1W
T1	Avel Lindberg	40/2515		

Circuit Ref.	*Description*	*Value*	*Tol.%*	*Rating*
F1	Fuse, Delay type 20 x 5mm			150mA 230V supply
	Delay type 20 x 5mm			300mA 115V supply
S101	Push button switch	Newrella SC150		2 C/O
PL1	3-pole mains r.f. filter			6A, 250V a.c.
SK1	3-pole mains connector			

6.9 Battery Supply Components

R1001	Carbon film	6.8K	5	½W
R1002	Wirewound	680	10	5W
R1003	Carbon film	1.5K	5	½W
RV1001	Preset, cermet 90H	1K	10	½W
VT1001	Transistor, NPN Texas	BC183LA		
D1001	Diode I.T.T.	1N4002		100V,1A
D1002	Zener diode, Int. Rect.	1ZM20T5	5	20V,1W
	Battery, Nickel Cadmium	3 x 7/225DK		25V, 225mAh
S1001	Slide switch	Waycom SSP 225R		
S1002	Slide Switch	Waycom SSP 225R		



Oscillator and Amplifiers

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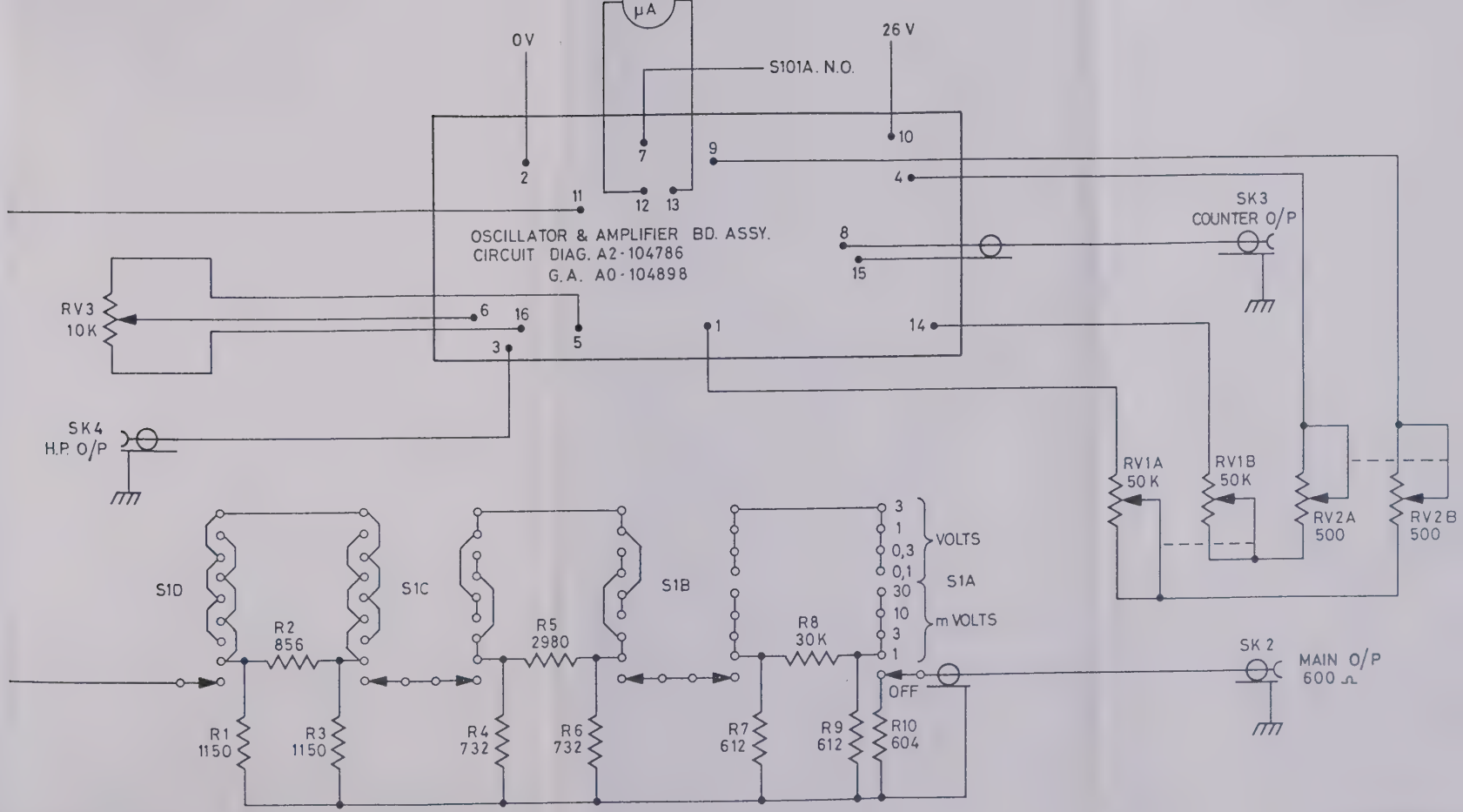
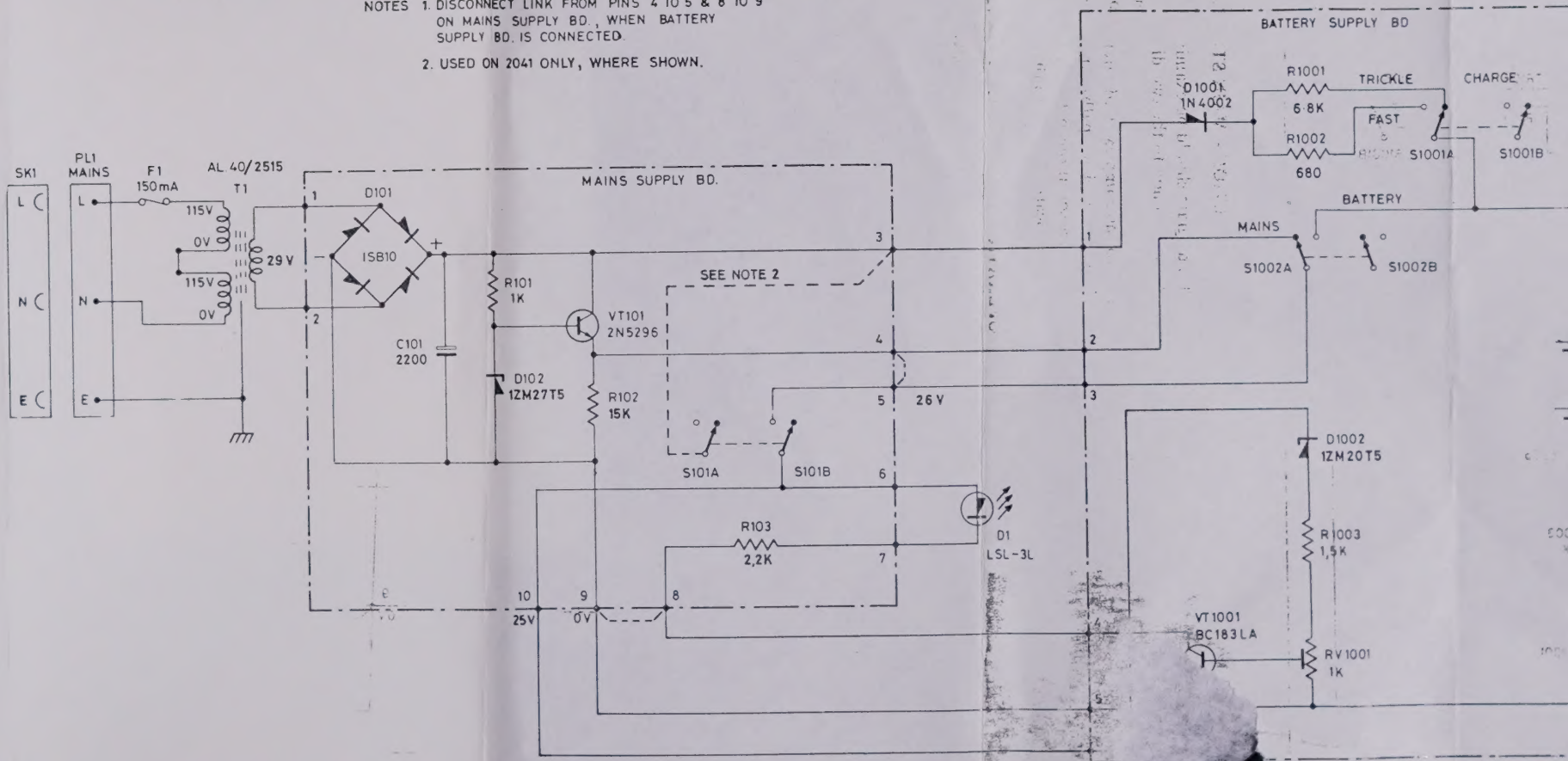


A.F. Signal Generator Type 2041

A3-104920-01

NOTES 1. DISCONNECT LINK FROM PINS 4 TO 5 & 8 TO 9 ON MAINS SUPPLY BD., WHEN BATTERY SUPPLY BD. IS CONNECTED.

2. USED ON 2041 ONLY, WHERE SHOWN.



Mains Supply with Battery Supply

A2-1050